

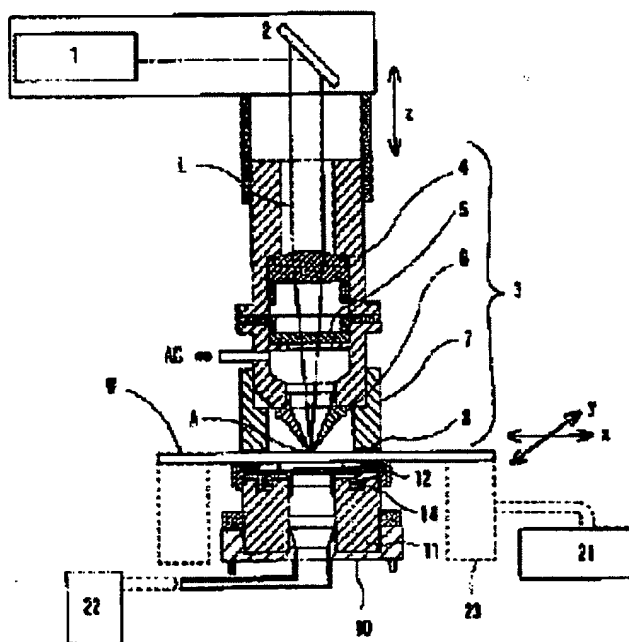
**LASER CUT MACHINING DEVICE FOR EXTRA THIN METAL PLATE**

**Patent number:** JP2003103388  
**Publication date:** 2003-04-08  
**Inventor:** NISHIWAKI YASUKI  
**Applicant:** NIPPON SHARYO SEIZO KK  
**Classification:**  
- international: B23K26/02; B23K26/00; B23K26/14; B23K101/18  
- european:  
**Application number:** JP20010293934 20010926  
**Priority number(s):** JP20010293934 20010926

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**Abstract of JP2003103388**

**PROBLEM TO BE SOLVED:** To provide a laser cut machining device for an extra thin metal plate wherein the variation in the position of a condensing point by an assist gas is restrained with a simple constitution. **SOLUTION:** On the lower part of a machining head 3, a holder 7, which encloses the outer periphery of a nozzle 6, and whose distance to the lower end coincides with a focal distance of a laser beam, is provided, and a support plate 12 energized upward by an elastic member 14 is provided direct below the machining head 3. In this way, the work W is energized upward by the elastic member to come into close contact with the holder 7, thereby the distance from a condenser lens 4 to the surface of the work can be always made constant.



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CLAIMS

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[Claim(s)]

[Claim 1] In the laser-beam-cutting processing equipment of the ultra-thin metal plate which injects an assist gas and carries out cutting processing while irradiating a laser beam from the nozzle of the processing head equipped with the condenser lens Laser-beam-cutting processing equipment of the ultra-thin metal plate characterized by having formed the holder whose distance to the lower limit section surrounds the periphery section of a nozzle and corresponds with the focal distance of a laser beam in the lower part of a processing head, and forming the support plate energized upwards by the elastic member directly under a holder in order to stick a workpiece to this holder.

[Claim 2] This support plate is laser-beam-cutting processing equipment of the ultra-thin metal plate according to claim 1 characterized by having prepared the adjustment cylinder in which height adjustment is possible in the cradle linked to the aspirator of an assist gas, and laying through an elastic member on it.

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## DETAILED DESCRIPTION

## [Detailed Description of the Invention]

[0001]

[Field of the Invention] Especially this invention relates to the equipment which performs detailed cutting processing of the ultra-thin metal plate by laser about laser-beam-cutting processing.

[0002]

[Description of the Prior Art] In case a surface mounted device is attached in a printed wired board in recent years, cream solder is beforehand printed to the printed wired board, and the case where laser beam machining makes the metal mask used for this printing has increased.

[0003] The sheet metal (0.1-0.5mm of board thickness) of stainless steel [ mask / this / metal ] is required to carry out detailed cutting at highly precise and high quality at the pattern predetermined by the laser beam. In such processing, a laser beam is made to condense as small as possible, and while making it there be no fluctuation of a focal location, it is necessary to inject an assist gas in the processing section effectively.

[0004] However, since heating momentarily and locally, fusing to a workpiece, and removing it by assist-gas \*\* injected from the laser beam same axle requires cutting processing by the laser beam, local bending (the flapping phenomenon is called) arises in the processing section with the injection pressure of an assist gas, and it has the problem of changing the condensing point of a laser beam.

[0005] Conventionally, JP,10-328867,A is one of those solved this. Tension be give to the workpiece base 34 , and this carry out stress maintenance of the workpiece W on it , and form bellows 40 between the processing head 35 and a nozzle 6 , and it put Workpiece W from the upper and lower sides , and he be try to restrain Workpiece W in the narrow field near condense [ laser ] point A with a nozzle 6 , the up presser foot member 30 of one , and the high lubrication plate 32 of the lower fixed surface plate 31 place in a fixed position by the lower part of a workpiece , as show in drawing 4 .

[0006] And for focusing of a laser beam, the contact process displacement gage 39 is formed in the right-and-left both sides of the processing head 35, this is connected by the connecting plate 41, and the up presser-foot member 30 is fixed to the lower part of a connecting plate 41. In addition, in drawing 4 , as for a condenser lens and 37, 4 is [ an X-axis driving shaft and 38 ] Y-axis driving shafts, and 36 is an NC control unit which the detection information on the contact process displacement gage 39 is memorized [ control unit ], and operates the X-axis driving shaft 37 and the Y-axis driving shaft 38.

[0007]

[Problem(s) to be Solved by the Invention] With above laser-beam-cutting processing equipment, since it has faced across near the laser beam processing location of a workpiece with the up presser-foot member 30 and the lower fixed surface plate 31, the workpiece of an ultra-thin plate can also control bending of the workpiece by the pressure of an assist gas.

[0008] However, when based on this approach, the parallelism of three elements of the up presser-foot member 30 and the lower fixed surface plate 31 which were attached in the processing head 35, and the workpiece base 34 must be high. If parallelism is bad, since a workpiece is forcibly forced on the lower fixed surface plate 31, it will tend to deform the part locally. Moreover, since a workpiece slides between the up presser-foot member 30 and the lower fixed surface plate 31, it is always necessary to press down the up presser-foot member 30 by the comparable pressure to the lower fixed surface plate 31, and, for that, the contact process displacement gage 39 etc. must adjust it. Therefore, not only enlarges, but equipment is complicated and there is a problem that wearing of the workpiece in cutting processing takes time amount.

[0009] Then, this invention aims at offering the laser-beam-cutting processing equipment of the ultra-thin metal plate which controlled location fluctuation of the condensing point by the assist gas with the simple configuration.

[0010]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the following means was taken in this invention. That is, while irradiating a laser beam from the nozzle of the processing head equipped with the condenser lens, in order to form the holder whose distance to the lower limit section surrounds the periphery section of a nozzle and corresponds with the focal distance of a laser beam in the laser-beam-cutting processing equipment of the ultra-thin metal plate which injects an assist gas and carries out cutting processing in the lower part of a processing head and to stick a workpiece to this holder, it is characterized by to form the support plate energized upwards by the elastic member directly under a holder.

[0011] This invention injects an assist gas while irradiating a laser beam from the fixed processing head, and it is applied to the laser-beam-cutting processing equipment which is made to carry out flat-surface migration of the workpiece of the sheet metal held to the X-Y stage, and carries out cutting processing. The holder surrounding the periphery section of a nozzle has a good cylinder-like thing. Moreover, when the lower limit section of a holder contacts a workpiece, the front face of die length of a holder of a workpiece corresponds with the focal distance of a laser beam automatically.

[0012] The support plate installed directly under a holder is for forcing a workpiece on a holder from a rear face, and is energized upwards by the elastic member. By this, a workpiece is restrained in the narrow range near a condensing point, and the location of a condensing point is uniformly held on a workpiece. An elastic member should just use proper things, such as a compression spring or India rubber. As for the location in which an elastic member is prepared, it is desirable to prepare more than one on a periphery so that the contact side of the lower

limit of a holder may be countered, and to make it a workpiece stick to a holder at homogeneity. Moreover, what is necessary is just to let the energization force (load-rate x amount-of-compression x number) of an elastic member be a proper thing with the quality of the material and thickness of a workpiece.

[0013] Through an elastic member, although the support plate is movable in the vertical direction, it is supported so that flat-surface migration cannot be performed. In addition, rotation is free and good. Since a workpiece is pinched by a holder and the support plate and it slides between them at the time of processing, it is desirable to prepare a sliding plate in the lower limit of a holder and the top face of a support plate, to make a sliding friction small, and to make it a blemish not attached to a workpiece.

[0014] Although it is simple to prepare in the top face of a cradle through an elastic member as for a support plate, since there is also the need for the height adjustment of a support plate and it is necessary to process an assist gas and molten metal at the time of processing, it is [ like ] desirable [ a support plate ] to prepare the adjustment cylinder in which height adjustment is possible in the cradle according to claim 2 linked to the aspirator of an assist gas, and to lay through an elastic member on it.

[0015] [Embodiment of the Invention] Hereafter, the example of an operation gestalt of the laser-beam-cutting processing equipment of the ultra-thin metal plate of this invention is explained based on a drawing. As shown in drawing 1, the interior of the condenser lens 4 which condenses laser beam L by which incidence is carried out through the reflective mirror 2 from the laser oscillation machine 1 is carried out to the processing head 3, and the nozzle 6 is formed in the lower limit. Moreover, the cover glass 5 for protecting a condenser lens 4 from the injection pressure of an assist gas AG is formed in the lower part of a condenser lens 4.

[0016] In addition, the processing head 3 is constituted by Z shaft orientations movable, and the nozzle 6 makes the assist gas AG a path (1.0mm or less) which flows into the processing part of Workpiece W intensively. Moreover, the assist gas AG is made into high pressure from the case of the usual laser beam machining.

[0017] On the other hand, Workpiece W is arranged on X-Y stage 23, is controlled by the NC control device 21 based on the cutting data set beforehand, and it is constituted so that it may learn and move to a predetermined configuration. The holder 7 of the shape of a cylinder surrounding a nozzle 6 is attached in the lower part of the processing head 3, and the field of the lower limit of a holder 7 is in agreement with the condensing point A of a condenser lens 4. In addition, the sliding plate 8 is attached to the lower limit side of a holder 7.

[0018] And the support plate 12 by which countered with the holder 7 and elastic support was carried out is arranged directly under the processing head 3. As this detail is shown in drawing 2, the adjustment cylinder 11 which can adjust height is fitted in and formed in a cradle 10, and the support plate 12 is laid in that upper part through the compression spring 14 which is an elastic member. That is, a male screw is formed in the periphery of the adjustment cylinder 11, it is engaging with the female screw of the inner circumference of the locating ring 15 which stopped to the cradle 10, and the height of the adjustment cylinder 11 is changed by rotating a locating ring 15. Moreover, a hole is formed in the upper part of the adjustment cylinder 11, it is equipped with the compression spring 14, and a support plate 12 is laid in a compression spring 14.

[0019] and the collar which fits into the periphery of the adjustment cylinder 11 while a support plate 12 has cylinder part 12a fitted in the inner circumference of the adjustment cylinder 11 -- 12b -- having -- \*\*\*\* -- a collar -- the male screw which engages with the female screw of the inner circumference holding a sliding plate 13 of a ferrule 16 is formed in the periphery of 12b.

[0020] Hole 10a connected to an aspirator 22 is formed in the center section of the cradle 10, and it has come change into a negative pressure condition at the time of laser beam machining. Next, an operation of the laser-beam-cutting processing equipment of the ultra-thin metal plate constituted in this way is explained.

[0021] While in carrying out cutting processing of the workpiece W performing focusing so that laser beam L by which outgoing radiation was carried out may connect Focus A to the front face of Workpiece W with a condenser lens 4 through the reflective mirror 2 beforehand from the laser oscillation machine 1, it adjusts so that the lower limit of a holder 7 may become the same flat surface as Focus A.

[0022] In addition, since it is placed in a fixed position by the processing head 3 and there is no fluctuation of the condensing point A, the future adjustments of a condenser lens 4, a nozzle 6, and a holder 7 are unnecessary only by carrying out once first. Moreover, what is necessary is just to perform adjustment of the lower limit location of a holder 7, when wear of the time of the board thickness of Workpiece W changing or a sliding plate 8 progresses.

[0023] It adjusts so that the height of a support plate 12 may also make the adjustment cylinder 11 go up and down and may become the location where the front face of Workpiece W is higher than the height location (location of the lower limit of a holder 7) of criteria 1-3mm or the other hand. Thus, since it is constituted, if it fixes Workpiece W to X-Y stage 23 and the processing head 3 is dropped, the point of a holder 7 will force Workpiece W and will push in a support plate 12. Thereby, Workpiece W is pinched by the support plate 12 and holder 7 which were energized by the compression spring 14 from the lower part, and the workpiece W located in the cylinder-like holder 7 is restrained by the flat surface which is in agreement with the condensing point A of a condenser lens 4.

[0024] At the time of cutting processing, an assist gas AG is injected by the high-pressure force towards Workpiece W from the nozzle 6 arranged on laser beam L and the same axle, and Workpiece W is controlled by the NC control device 21 based on the cutting data set up beforehand, and it moves it with it. And Workpiece W is fused locally and momentarily according to the heat input of a laser beam, and is attracted through hole 10a of a cradle 10 to an aspirator 22 from the center of the support plate 12 which is in the negative pressure condition.

[0025] Since Workpiece W slides in the condition of it having been pushed by the compression spring 14 with the support plate 12 energized from the lower part, and having always stuck to the lower limit of a holder 7 by it, the point A condensing [ laser ] becomes always fixed, and is not changed. In addition, though bending appears in Workpiece W with the gas pressure of an assist gas AG, since it is very small, it is a constant rate and the point condensing [ laser ] is not changed relatively, the cutting quality, configuration precision, and dimensional accuracy of a product become the stable thing.

[0026] Moreover, during cutting processing of Workpiece W, since the top face slides on the sliding plate 8 of the lower limit of a holder 7, and a rear face with the sliding plate 13 on a support plate 12 and moves in them, a sliding friction moves smoothly small and Workpiece W is not damaged. Moreover, a hole 17 is formed in the center, the spiral concave 18 which eases a sliding friction with Workpiece W is minced by the top face, and the sliding plate 13 has mitigated the load of X-Y stage 21, as shown in drawing 3. In addition, if coolant gas is passed to the spiral concave 18, the cooling effect can work to Workpiece W and the effect of the heat of an amputation stump side can be controlled more.

and also it is effective in dross stopping being able to adhere easily.

[0027]

[Effect of the Invention] As explained above, the laser-beam-cutting processing equipment of this invention Since the holder whose distance to the lower limit section surrounds the periphery section of a nozzle and corresponds with the focal distance of a laser beam was formed in the lower part of a processing head, and the support plate energized upwards by the elastic member directly under a holder was formed in order to stick a workpiece to this holder The distance between a condenser lens and a workpiece (focal location) can always be kept constant during cutting processing, and the stable sectility ability which does not have fluctuation in cutting width of face as a result is obtained. Moreover, adjustment by a contact displacement gage like before etc. is not needed at the time of the set of a workpiece, either, but to various board thickness, a make-ready time is unnecessary and it is effective in being easy to deal with it, since it is a simple configuration. Furthermore, if the adjustment cylinder in which height adjustment is possible is prepared in the cradle according to claim 2 linked to the aspirator of an assist gas like and a support plate is laid through an elastic member, since an assist gas and molten metal will be eliminated immediately, there is also almost no adhesion of dross and a quality cutting plane can be obtained.

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